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ORIGINAL

July 8, 1999

U. S. Department of Transportation Dockets,
Docket No. FAA-1999-5401,
400 Seventh St. SW., Room Plaza 401
Washington, DC 20590

Attention: Rules Docket No. FAA-1999-5401 -16

I am writing this letter in response to NPRM Docket # FAA-19993401 on behalf of Hyannis Air Service, Inc. d/b/a Cape Air/Nantucket Airlines and its four hundred and fifty employee owners. Hyannis Air Service, Inc. is the largest, non-affiliated regional airline in the United States and is the largest operator of Cessna Model 402C aircraft in the world. Since 1989, Hyannis Air Service, Inc. has operated in excess of two hundred thousand flight hours, over six hundred thousand scheduled departures, and has carried approximately three million passengers. We are completely dependent on the Cessna 402C, as it is our only aircraft type.

Currently, in 1999, Hyannis Air Service, Inc. operates forty-seven Cessna Model 402C aircraft. We will operate these aircraft over forty-five thousand-flight hours; one hundred fifteen thousand scheduled departures, and carry over five hundred thousand passengers.

We support FAA and industry efforts to improve the safety of all aircraft with the respect to aging. We therefore support the goals of the proposed NPRM. We also believe that by working with the FAA and Cessna Aircraft, we have been able to continually improve our existing FAA approved maintenance inspection, repair, and training procedures with regards to the Cessna 402C, and have proven to achieve the same level of safety and reliability as the proposed method(s).

At this time, it is impossible to quantify the actual economic impact to Hyannis Air Service, Inc., due to the lack of an existent damage tolerant inspection program for the Cessna 402C aircraft. We believe that compliance to the NPRM as currently proposed could create undo economic hardship without a commensurate improved level of safety.

In any event, we have the following concerns with regards to the NPRM:

1) We feel that the proposal to have the FAA or an FAA representative conduct a records review and inspection of aging aircraft to determine the airworthiness of the

carrier's aircraft is not justified. Air Carriers would be reliant on availability of government employees (or government representatives) to be properly trained and to comply with these inspections in a timely manner, thus allowing the government to have a major impact on the viability of a private company.

2) With respect to the design life goal of 7,700 hours for the Cessna 402C wing structure mentioned in the NPRM, refer to the attached copies of DOT/FAA/AR-98/66, Supplemental Inspection Document Development Program for the Cessna Model 402 paragraphs 3.5.2 fail-safe Tests, 3.5.2.1 Empennage Fail-Safe Tests, 3.5.2.2 Wing Fail-Safe Tests, 3.5.3 Fatigue Analysis, and Cessna Aircraft Company M402 SID Intern Paper 2 report No. S-402-76-2 paragraph 6.2.2 Wing Fail-Safe Tests and 6.2.2.1 Fatigue Analysis.

We believe that the attached FAA and Cessna Aircraft Company documents do not support designed life goals for the Cessna 402C aircraft. All tests were conducted on twenty-year old aircraft primary structures and showed full compliance with fail-safe requirements of FAR 23.572.

This proposal as currently written could create an unprecedented economic burden on our operation and jeopardize our overall financial viability as well as the only scheduled air service to many of the small communities that we serve.

Sincerely,

James S. Goddard
Director of Maintenance

DOT/FAA/AR-98/66

Office of Aviation Research
Washington, D.C. 20591

Supplemental Inspection Document Development Program for the Cessna Model 402

March 1999

Final Report

U.S. Department of Transportation
Federal Aviation Administration

3.5.2 Fail-Safe Tests.

Fail-safe tests were conducted to determine the fail-safe characteristics of the Model 402C wing and empennage. The results show compliance with the fail-safe requirements of FAR 23.572. The fail-safe test results demonstrate that catastrophic failure or excessive deformation which could adversely affect the aircraft flight characteristics will not occur after fatigue failure or obvious partial failure of a single principal structural element. The details of these tests are presented in the following paragraphs.

3.5.2.1 Empennage Fail-Safe Tests.

A -series of fail-safe tests were conducted on the Model 402C empennage. Six fail-safe conditions, two vertical stabilizer and four horizontal stabilizer conditions, were tested. The selection of these test conditions was based on field experience as well as an extensive analytical evaluation of the empennage structure. The empennage structure was evaluated in two steps. First, the internal loads output from the NASTRAN model of the empennage was reviewed to determine the critical components of the empennage for the critical loading conditions. Second, the NASTRAN model was run for the critical load case with the critical components failed in the model. The internal loads output from each failure was reviewed to determine which failures would be the most critical. If the NASTRAN model showed either a significant loss in margin of safety or a negative margin of safety with one of its elements removed then that location was chosen for testing.

The tests were conducted on an empennage (tailcone and horizontal and vertical stabilizers) obtained from a salvage yard. This is the same article used for the ground tests. Two types of fail-safe damage were used on the Model 402C empennage test article: (1) bolt removal and (2) saw cuts. When possible, bolts were removed to simulate damaged or failed members to preserve the test article as much as possible. The test article was returned to the original or equivalent strength by replacing the bolts and by structural repair of the saw cuts.

The empennage test article was loaded to a minimum of 86.25% of the critical limit load [75% of the critical limit load x 1.15 dynamic factor] to show compliance with the fail-safe requirements of FAR 23.572. The remaining structure supported the load without excessive deformation or failure for each of the six fail-safe conditions.

3.5.2.2 Wing Fail-Safe Tests.

A single fail-safe test was conducted on the Model 402C wing. The wing front spar lower cap was cut at WS 80.05. The selection of this test condition was based on an extensive analytical evaluation of the wing structure.

The wing structure was evaluated in two steps. First, the internal loads output from the NASTRAN model of the wing was reviewed to determine the critical components of the wing structure for the critical loading conditions. Second, the NASTRAN model was run for the critical load case with the critical components failed in the model. The internal loads output from each failure was reviewed to determine which failures would be the most critical. If the NASTRAN model showed either a significant loss in margin of Safety or a negative margin of safety with one of its elements removed, then that location was chosen for testing. Four locations were considered for fail-safe testing. One fail-safe condition was tested, while the other three fail-safe conditions were evaluated analytically.

The fail-safe test was conducted on a left-hand wing obtained from a salvage yard, attached to a Model 425 fuselage. A Model 402C right-hand wing was obtained to use as a loading fixture. The Model 402C wing was fail-safe tested using one loading condition: maximum positive bending. The test condition covers the positive load envelope. The load envelope is a composite of the flight critical loads, based on requirements of CAR conditions 3.183 through 3.190. The test article was loaded to 86.25% of the critical limit load [75% of the critical limit load x 1.15 dynamic factor] to show compliance with the fail-safe requirements of FAR 23.572. The article was then loaded to 100% of the critical limit load. Strain gauge and deflection data were recorded during the test.

Fail-safe analyses were conducted for three wing locations in lieu of testing. An analysis was also conducted for location W-l and compared to the fail-safe test results. The results show compliance to a minimum of 86.25% of the critical limit load [75% of the critical limit load x 1.15 dynamic factor] per the fail-safe requirements of FAR 23.572.

3.5.3 Fatigue Analysis.

Fatigue analyses were conducted for the Model 402 through "B" and Model 402C airframe locations shown in section 2.2.4. The fatigue analysis was conducted to give an indication of economic life of the airframe. The fatigue analysis results of the landing gear and the airframe structure proven to be fail-safe were used to determine initial inspection intervals.

Fatigue analyses are based on the Palmgren-Miner linear cumulative damage theory where the life limit is established when the summation of applied cycles divided by cycles to crack initiation equals one. These analyses incorporate the repeated loads spectra, stress equations, net area factors, and transfer factors defined for each analysis location. The stress endurance data used was based on cyclic test experience.

The S-N curves used for aluminum structure are based on previous full-scale and component fatigue test history at Cessna for similar structure and spectra. This method has advantages over methods where stress concentration factors are calculated and damage is cumulated through S-N curves based on K_t. The Cessna method will account for fretting and clamp-up that would be difficult using the K_t approach.

The analytical mean life predicted by the analysis is defined as the time when 50% of the fleet aircraft are expected to have developed small cracks (typically 0.05 inch 'in length). The analytical mean life is based on a severity index, K_f. The severity index is representative of the specific geometric stress concentration for each location, the material condition, and previous cyclic test results of Cessna aircraft. For the Model 402, analyses were conducted for a range of K_f values from 3 .O to 9.0. The S-N curves are graded according to their K_f value from a mild 3 .O to a severe 9.0. The severity index was then selected based on cyclic test data. If cyclic test data were not available for the location, a K_f value of 6.0 was selected. Selection of this K_f factor is considered conservative compared with the actual derived K_f's from other Cessna tests of similar structure.

The mean life was divided by a scatter factor. The scatter factor chosen is based on the guidelines of reference 6. For those locations with fatigue test data available a scatter factor of 4 was chosen. For those locations without test data, a scatter factor of 8 was chosen.

CESSNA AIRCRAFT COMPANY
AIRCRAFT DIVISION
WICHITA, KANSAS 67277

STRUCTURES

MODEL NO: 402 REPORT NO: S-402-76-2

M402 SID INTERIM PAPER 2

REPORT DATE: June 5, 1997

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6.2.2 Wing Fail Safe Tests

A single fail safe test was conducted on the Model 402C wing. The wing front spar lower cap was cut at WS 80.05, as defined in the Fail Safe Test Proposal (Reference Appendix B, Section B.6.1). The selection of this test condition was based-on an extensive analytical evaluation of the wing structure.

The analytical evaluation of the wing structure was accomplished in two steps. First, the internal loads output from the NASTRAN model of the wing was reviewed to determine the critical components of the wing structure for the critical loading conditions. Secondly, the NASTRAN model was run for the critical load case with the critical components faiied in the model. The internal loads output from each failure was reviewed in order to determine which failures would be the most critical. If the NASTRAN model showed either a significant loss in margin of safety or a negative margin of safety with one of its elements removed then that location was chosen for testing. The details of this evaluation are presented in Section B.6.2 of Appendix B. Four locations were considered for fail safe testing. One fail safe condition was tested, while the other three fail safe conditions were evaluated analytically.

The fail safe test was conducted on a left hand wing obtained from a salvage yard, attached to a Model 425 fuselage. A Model 402C right hand wing was obtained to use as a loading fixture. This is the same article used for the ground tests (Reference Section 3.1.4.1 of Cessna Report S-402-76-2, "M402 Interim Paper 1").

The Model 402C wing was fail safe tested using one loading condition - maximum positive bending. The test condition covers the positive load envelope. The load envelope is a composite of the flight critical loads, based on requirements of CAR conditions 3.183 through 3.190.

The test article was loaded to 86.25% of the critical limit load [75% of the critical limit load x 1.15 dynamic factor] to show compliance with the fail safe requirements of FAR 23.572. The article was then loaded to 100% of the critical limit load.

Strain gauge and deflection data were recorded during the test. A comparison of the measured unfailed stresses verses each faiiure stress is shown in Section B.6.3 of Appendix B.

6.2.2.1 Fail Safe Analyses

Fail safe analyses were conducted for three wing locations in lieu of testing. An analysis was also conducted for location W-l and compared to the fail safe test results. The selection of the analysis locations is discussed in Section 6.2.2. The details of the analyses are presented in Appendix B, Section B.6. The results show compliance to a minimum of 86.25% of the critical limit load [75% of the critical limit load x 1.15 dynamic factor] per the fail safe requirements of FAR 23.572.